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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/965,373	09/26/2001	Hua Chung	APPM/6303.02/CPI/COPPER/P	6509

32588 7590 09/08/2003
APPLIED MATERIALS, INC.
2881 SCOTT BLVD. M/S 2061
SANTA CLARA, CA 95050

EXAMINER

LOUIE, WAI SING

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 09/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/965,373

Applicant(s)

CHUNG ET AL.

Examiner

Wai-Sing Louie

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 June 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 7,9,11,12,14,16,17,19,20,22,24,25,27,28 and 30-38 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 7,9,11,12,14,16,17,19,20,22,24,25,27,28 and 30-38 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2,3,4. 6) ☐ Other: _____

DETAILED ACTION

Applicant argues that Group I, II, and III are related and should not be restricted. However, Group I is drawn to a physical vapor deposition process; Group II is drawn to a specific processing chamber; and Group III is a system for processing a substrate. They belong to different classes and require different search. Therefore, the restriction is proper.

Claim Objections

Claim 27 is objected to because of the following informalities:

- Claims 27-28 are depending on a canceled claim. For the purpose of examination, claims 27 and 28 are assumed to be depended on claim 22.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 7, 9, 11-12, 14, 16-17, 19-20, 22, 24-25, 27-28, and 30-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cohen (US 6,610,151) in view of Kang et al. (US 6,139,700) and Wang et al. (US 6,387,806).

With regard to claim 7, Cohen discloses an apparatus for forming a seed layers for interconnects of a semiconductor device (col. 5, line 30 to col. 14, line 25 and fig. 7) comprising:

- Cohen discloses a chamber 76 for depositing a barrier layer 18 in via 16 (col. 6, lines 1-19 and fig. 1), but does not disclose the barrier layer 18 is deposited by atomic layer deposition. However, Cohen discloses the apparatus is flexible enough and able to switch to ion plating, ionized metal plasma deposition, or atom deposition and controlling the deposition rate (col. 12, line 61 to col. 13, line 14). Kang et al. disclose the atomic layer deposition (ALD) is similar to CVD with the exception of reaction gases are introduced into the chamber (Kang col. 1, lines 54-62). Kang et al. teach the ALD has an excellent surface coverage, i.e., 100% (Kang col. 2, line 3). Therefore, it would have been obvious at the time the invention was made to modify Cohen's device with the teaching of Kang et al. to switch the barrier deposition chamber 76 to ALD chamber in order to have an excellent coverage in the via 16.
- A chamber 77 for depositing a copper (Cu) alloy seed layer, but do not disclose the alloy concentration is between 0.01 to 2.0 atomic percent. However, Wang et al. disclose the Cu alloy contains 0.01 to 1 atomic percent of alloy elements (Wang col. 7, line 2). Wang et al. teach the 0.01 to 1.0 atomic percent is the solid solubility of metal dopant in Cu (Wang col. 7, lines 1-4). Thus, it would have

been obvious for the one with ordinary skill in the art to modify Kang's device with the teaching of Wang et al. to provide 0.01 to 1 atomic percent of metal dopant in Cu layer it is because 0.01 to 1 atomic percent is the suitable solid solubility of element in Cu. Wang et al. disclose zirconium is one of the element in the Cu alloy (Wang col. 6, line 61).

With regard to claims 9, 11, 16, and 24, Cohen discloses the Cu alloy seed layer 20 could be deposited by chemical vapor deposition (CVD) or physical vapor deposition (PVD) in chamber 77 (col. 10, lines 41-48).

With regard to claims 12, 20, and 28, Cohen disclose a transfer chamber 73 for transferring a substrate 10 between the barrier chamber 76 and Cu seed chamber 77 (col. 11, line 65 to col. 12, 3 and fig. 7).

With regard to claims 14, 17, 22, and 25, in addition to the limitations disclosed in claim 7, Cohen also discloses:

- An non-conformal (undoped) Cu seed layer 22 deposition chamber 78 (col. 12, lines 5-6 and fig. 7). The non-conformal Cu seed layer 22 could be deposited by chemical vapor deposition (CVD) or physical vapor deposition (PVD) in chamber 77 (col. 10, lines 41-48).

With regard to claims 19 and 27, Cohen discloses the Cu alloy seed chamber 77 is a PVD chamber and the non-conformal (undoped) Cu seed chamber 78 is a CVD chamber. Since the chambers are adoptable to switch the deposition process (col. 10, lines 41-48), the Cu layers deposition could be done in either deposition process.

Art Unit: 2814

With regard to claims 30 and 38, Cohen, modified by Kang et al. in claim 7 above, would disclose the barrier layer 18 deposited by ALD process in chamber 76 and the barrier layer is made of TaN (col. 6, line 6).

With regard to claims 31-37, Cohen discloses the Cu alloy seed layer 20 is deposited directly on the TaN barrier 18 (fig. 1).


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Wsl

26 August, 2003



LONG PH
PRIMARY EXAMINER